Structural Integrity Research of Commuters

Michael Shiao

Research Project Manager

FAA William J. Hughes Technical Center

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Presentation Outline

- National Aging Aircraft Research Program
- Structural Integrity Research of Commuters
  - Development of Supplemental Inspection Document (SID) for Commuter Category Airplanes
  - Airworthiness Evaluation of High-Time Small Airplanes
- Summary

National Aging Aircraft Research Program

- As a result of accidents in the 1980s, Congress passed the Aviation Safety Research Act of 1988 (Public Law 100-591)
- In response, the FAA developed the National Aging Aircraft Research Program
- Research focuses on improving means to keep aging airplanes safe
  - Better understand the physics of aging
  - Improve analytical methods
  - Enhance inspection methods
  - Characterize the loads

National Aging Aircraft Research Program

- Structural Integrity Research
  - Large Transport
  - **Commuters**
  - Rotorcraft
- Inspection Systems Research
- Aircraft Engine Research
- Airborne Data Monitoring Systems Research
- Aging Electrical Systems
- Aging Mechanical Systems

Structural Integrity Research of Commuters -- 1990s

- Development of damage tolerance (DT)-based repairs analysis tool (RAPIDC) 1994-2002
- Development of a DT-based SID for commuter category airplanes 1995-2000

Development of a DT-Based SID for Commuter Category Airplanes

- Background
  - DT-based SIDs successfully provide a high level of safety for large transports
  - FAA considered extending this concept to commuters
- Purpose
  - Determine if DT-based SIDs for commuters are practical
  - Develop and recommend methods for DT-based SIDs
  - Develop a DT-based SID

Commuter SID Contracts

- Contracts awarded to commuter mfgs
  - Cessna -- M402 started in 1995
  - Fairchild -- SA 226/227 started in 1996
- Both models are used in commuter service
- Both companies
  - have required technical capabilities
  - are willing to conduct the investigation

SID Contract Requirements

- Structural Evaluation
  - Identify the Principal Structural Elements (PSE)
  - Identify the critical areas of PSE
  - Perform the following tasks for each critical area
    - Develop stress spectrum
    - Establish initial flaw sizes
    - Determine inspectable flaw sizes
    - Perform crack growth analysis
    - Establish supplemental inspection thresholds
    - Establish repeat inspection interval
  - Collect Material Property Data
  - Determine the onset of widespread fatigue damage
- Development of SID

Proprietary Data in Cessna's SID Contract

- **Cessna's final proposal was included in the FAA's Contract with Cessna by the following statement in the contract:**

  "The contractor shall provide the following in accordance with the specifications in the Section C, Contract Statement of Work, and contractor's revised proposal dated September 26, 1995"

Proprietary Data in Cessna's SID Contract

- **Clarification of proprietary data stated in the revised proposal**

  "*Airplane specific spectrum and stress data and other analysis input data developed at Cessna expense will be treated as proprietary data.*

  Proprietary data will include actual stress data, even though developed as part of this program, and material data not currently available in the public domain which has been developed at Cessna's expense.

  Cessna proprietary data used will be furnished to the FAA for purposes of reviewing the analyses and resulting SID but will not be available for public dissemination."

Proprietary Data in Cessna's SID Contract

- General data protection clause:
  - 4.4 "…The requirements to provide data at such presentations shall be in accordance with FAR (Federal Acquisition Regulation) 52.227-11, Patents Rights – Retention by the Contractor, Short Form, (April 1984) and FAR 52.227-14, Rights in DATA – General (June 1987), Alternatives I, II, and III (June 1987)."
- Similar to Fairchild Contract

Cessna's SID Contract Results

- Deliverables
  - Interim Working Papers I and II
  - SID report published as DOT/FAA/AR-98/66
- Research Findings
  - DT-based SID can improve level of safety
  - DT concepts are applicable to commuters
  - DT-based SID development requires expertise
  - DT-based SID development is expensive

Structural Integrity Research of Commuters -- now

- Data & Methodologies for Structural Life Evaluation of Small Airplanes
- Airworthiness Evaluation of High-Time Small Airplanes

Airworthiness Evaluation of High-Time Small Airplanes -- Purpose

- To provide insight into the condition of an aged general aviation (GA) airplane and see if there is a correlation between its maintenance and apparent condition
- Not intended to provide statistical evidence for guideline development for inspection

Objectives

- Assess Aging of Commuter Airplanes
  - Physical condition
  - Maintenance/inspection programs
- Provide Generic Inspection Guidance
  - Additional inspections for aged GA airplanes?
    - One-time inspection at some age?
    - More thorough inspections for aged airplanes?
- Determine Generic Degradation Indicators
  - Structures (corrosion/cracking)
  - Electrical Systems/Wiring
  - Fuel/Hydraulic/Pneumatic Systems
  - Mechanical Systems

Teardown Process

- Major disassembly of airplane sections for PSEs
- Preliminary engineering inspection as well as SID inspection of critical areas in PSEs
- Detail disassembly of the critical areas
- Metallurgical inspection of detail parts in the PSEs
- Compare discovered anomalies (cracks, corrosion, system deterioration) with FAA Service Difficulty Reports (SDR) data
- Documentation of teardown inspection results

Model Selection

- Small Airplane Fatigue Working Group consensus
- Mfg and large/commuter operators' support
- Typical of small commuter and GA
- Established inspection program (SID)
- Representative of a large portion of the small airplane commuter fleet
- Share design commonality with other airplanes

Current Status

- High-time C-402A torn down in FY03
- High-time C-402C teardown in progress
- Next airplane model not determined
- Project has generated interest in aging GA airplanes
  - Useful information for GA owners about aging concerns
  - Useful data for improving “Best Practices Guideline for Maintaining Aging General Aviation Airplanes”

Summary

- Outcome of SID Research
  - DT-based SID can improve level of safety
  - DT concepts are applicable to commuters
  - Methods were developed and recommended for DT-based SID
- Benefit of Teardown Research
  - Better understand the impact of aging process on the structural integrity of small airplanes
  - Develop generic inspection guidelines
  - Provide useful information to GA owners about aging concerns
  - Provide useful data for improving “Best Practices Guideline for Maintaining Aging General Aviation Airplanes”